

5 Florida Observations

5.1 Flood Observations: Damages and Successes

Based on the aerial survey and ground reconnaissance, the BPAT did not expect to observe any significant structural damage to buildings in Florida. Areas inundated by riverine or coastal flooding suffered losses to interior contents, finishes, wallboard, insulation, and electrical wiring.

5.1.1 Riverine Flooding

Flooding was extensive in the Yellow River, Perdido River, Escambia River, and Blackwater River watersheds in Florida. The recurrence intervals for the floods caused by Hurricane Georges exceeded the 100-year threshold for the Shoal and Yellow Rivers in the Yellow River watershed (see Figure 2-4, Section 2). Floods were estimated between the 50- and 100-year recurrence interval for the Perdido River in the Perdido River watershed, the 25-year recurrence interval for the Escambia River in the Escambia River watershed, and between the 25- and 50-year recurrence interval for the Blackwater River watershed.

The BPAT visited sites of riverine flooding along the Yellow and Shoal Rivers in Okaloosa and Santa Rosa Counties. The home shown in Figure 5-1 was flooded by several feet of water and is typical of the pre-FIRM, at-grade houses located in these areas.

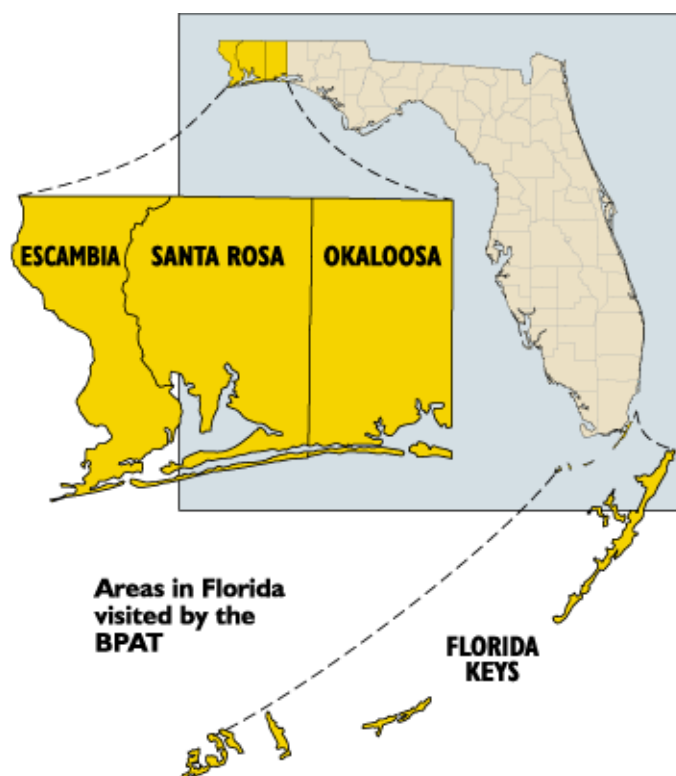




FIGURE 5-1 Repetitively flooded home slated for acquisition under FEMA's HMGP.

In accordance with the County's NFIP compliant floodplain management requirements, the replacement home shown in Figure 5-2 was recently built to the BFE with a Small Business Administration (SBA) disaster loan after flooding damaged it earlier this year. Floodwaters exceeded the BFE, reaching approximately 3 feet above the first-floor elevation. While the construction of the home to the BFE reduced the damages from Hurricane Georges — and will protect against damage from less intense, future storms — a residual risk still remains from floods exceeding the BFE. A freeboard requirement would have further reduced the risk of flooding. Fortunately, a condition of the SBA loan required the property owner to maintain flood insurance coverage on the home. Proceeds from the insurance claim will help the homeowner recover from this flood.



FIGURE 5-2 A high water mark is visible approximately 3 feet above the first floor elevation. The house, located along the Shoal River in Okaloosa County, suffered little damage because insulation and wallboard had not yet been installed.

The BPAT assessed damage from riverine flooding on the Shoal River that exceeded the base flood level by several feet. Homes elevated to the BFE flooded when water levels exceeded the BFE, as was the case with the home in Figure 5-2. Homes built outside, but adjacent to, the SFHA were flooded when water levels exceeded the limits of the SFHA. Homes in Figure 5-3 were built in the last five to seven years and they experienced significant flooding and damage when water levels exceeded the BFE and the limits of the SFHA.

The 100-year (24-hour) rainfall in the vicinity of Crestview is 13 inches [NWS 1961]. Hurricane Georges exceeded the 100-year rainfall by producing approximately 20 inches of rainfall in the Crestview area [NWS 1998]. A USGS river gaging station on the Shoal River near Crestview, Florida, is located just upstream of the neighborhood where the homes in Figure 5-3 are located. During the storm, a record height of 21.40 feet above the gage datum was recorded; the previous peak height was 15.58 feet. This new record corresponds to 68.61 feet, referenced to the National Geodetic Vertical Datum (NGVD). The neighborhood is located approximately 1,000 feet downstream of the gaging station, and the first floor elevations of the homes range from 62.0 to 64.5 feet (NGVD). The BFE at this site is 61.4 feet. The BPAT observed flooding depths of 3 to 4 feet in these homes, indicating that the flood was greater than a 100-year event.

The flood discharge along Shoal River is estimated to have reached 59,000 cfs, more than twice the previous peak discharge record. This discharge is estimated to have a 300- to 400- year recurrence interval, far exceeding the discharge of the 100-year flood event, which is estimated at approximately 32,000 cfs.

Several other rivers in the Florida Panhandle region experienced floods of equal magnitude. The Perdido River at Barrineau Park, near the Florida/Alabama border, reached flows of 44,000 cfs, which is estimated to have a recurrence interval of 50-100 years. The previous peak discharge of record was 39,000 cfs, occurring in 1995. Additionally, Elevenmile Creek near Pensacola, Florida peaked at about 13,000 cfs, which is also estimated as a 100- to 200-year event.

While locating homes directly adjacent to but outside the SFHA may eliminate both the mandatory flood insurance purchase requirement and floodplain management construction requirements, the risk of flooding is not completely eliminated. This residual risk, without the financial protection of flood insurance coverage, left many homeowners whose flooded homes were located outside the SFHA, ill-prepared to recover from flood damage caused by Hurricane Georges.

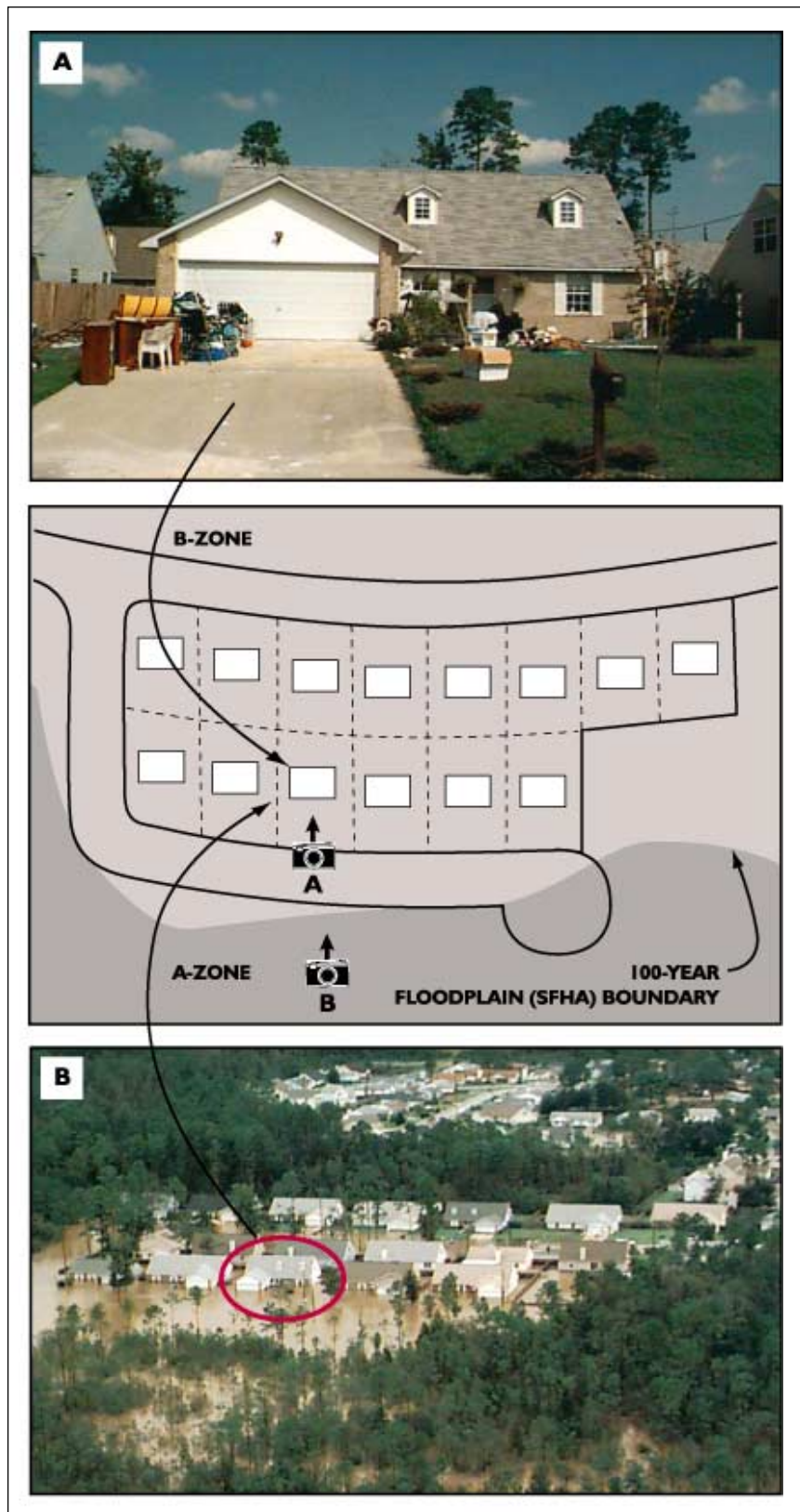


FIGURE 5-3 The home pictured above is one of approximately 10 homes in this subdivision which experienced flood depths of 2 to 3 feet when the water levels exceeded the BFE and extended beyond the limits of the SFHA.

5.1.2 Coastal Flooding

The BPAT conducted an aerial inspection of the coastal areas of Florida from Pensacola Beach to Navarre Beach. On-the-ground inspections of coastal damages were confined to Pensacola Beach.

In Pensacola Beach, prolonged wave attack and storm-surge flooding associated with the hurricane eroded most of the primary dune system and narrowed the beach (Figures 5-4 and 5-5). Overwash was significant, but not as severe as experienced during Hurricane Opal. Vertical sand accretion beneath some structures was 3 to 5 feet. Even after Hurricane Georges, Pensacola Beach remains relatively wide with scattered residual dunes. Offshore sandbars were observed migrating back onto the beach in some locations.



FIGURE 5-4 Pensacola Beach before Hurricane Georges.



FIGURE 5-5 Pensacola Beach after Hurricane Georges. Note the loss of dune and vegetation in the foreground of the photo.

Much of the sand that was washed inland buried roads, utilities and lower areas of buildings. As shown in Figure 5-6, homeowners removed excess sand.



FIGURE 5-6 Excess sand (circled) from beneath houses and on roadways that was returned to the beach.

The volume of overwashed sand made the road from Pensacola Beach to Navarre Beach impassable. Reportedly, significant portions of the post-Hurricane Opal reconstructed dune in Navarre Beach were lost (Figures 5-7 and 5-8).



FIGURE 5-7 Navarre Beach before Hurricane Georges.



FIGURE 5-8 Navarre Beach after Hurricane Georges. Note the loss of revegetated dune.

In Pensacola Beach, post-FIRM elevated structures performed well, suffering only residual damage to storage, access, and parking areas below the first floor (Figure 5-9). In V-Zone areas, the BPAT observed minimal enclosures below the first floor of elevated structures. Breakaway walls, where observed, performed as intended.



FIGURE 5-9 The structures to the left were elevated and set back and performed well.

The house in Figure 5-10 clearly illustrates the reduction in flood damages that occur when homes are properly elevated. The elevated addition suffered no damage while the pre-existing, at-grade portion of the home suffered extensive flood damage from overwash.



FIGURE 5-10 An existing slab-on-grade home was expanded with a properly elevated addition.

The BPAT also investigated the performance of several Pensacola Beach hotels. Older, pre-FIRM buildings, such as the hotel in Figure 5-11, suffered flood damage. Flood and rain damage forced the hotel in Figure 5-11 to close for repairs. The property management company reported that it would be closed for three to four months, forcing the layoff of approximately 50 housekeeping and support staff. In contrast, newer hotels with elevated first floors in compliance with the current floodplain management ordinance suffered minimal damage (Figure 5-12). The hotel in Figure 5-12 suffered minimal damage and was able to continue operations without disruption.



FIGURE 5-11 An older hotel that suffered significant damage to the interior due to storm surge and roof leakage.



FIGURE 5-12 A newer hotel with an elevated first floor that suffered minimal damage.

5.2 Wind Observations: Damages and Successes

In general, Hurricane Georges caused minimal wind damage in Florida. Buildings highly exposed along the open coast suffered some wind damage, including loss of sections of composition roof shingles and small sections of siding, which allowed rain infiltration to damage building interiors and contents (Figure 5-13).



FIGURE 5-13 The house on the left suffered wind damage to roofing shingles.

The BPAT assessed the performance of several window and door shutter projects funded under FEMA's HMGP. The shutter projects were applied to public buildings, including municipal office buildings, fire stations, and police stations. While there was little evidence that wind forces and airborne debris caused damage to windows and doors in the area, buildings with shutters showed no damage and provided a safe and secure shelter facility during the hurricane (Figures 5-14 to 5-16).



FIGURE 5-14 Window shutters on the Pensacola Fire Station No. 4.



FIGURE 5-15 Window shutters on the Pensacola Police Headquarters.

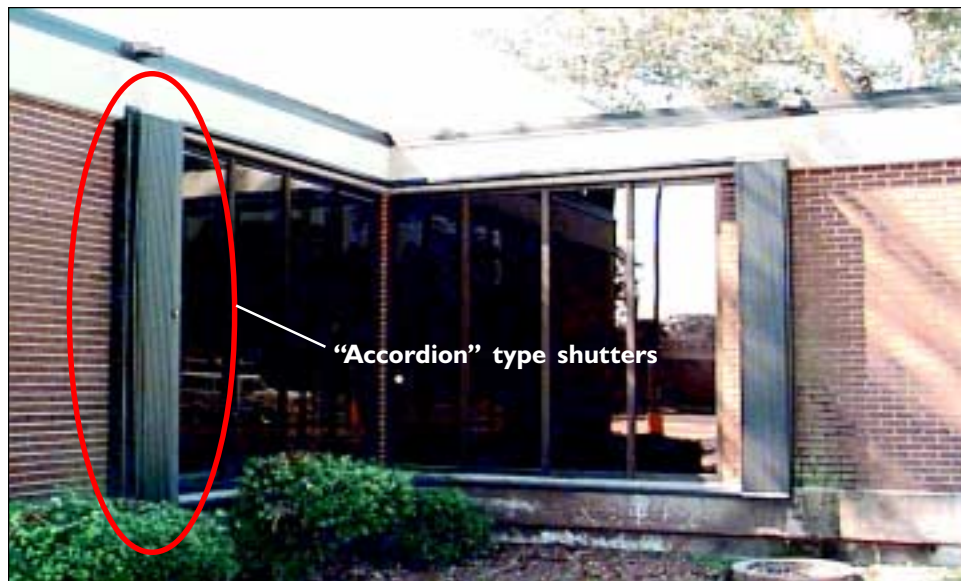


FIGURE 5-16 Window shutters on the Escambia County Administration Building.

5.3 Manufactured Homes in the Florida Keys

On October 11, 1998, damages to manufactured homes on Cudjoe Key, in Monroe County, Florida, were assessed. Wind gusts were estimated at 105-110 mph in this area [NWS 1998]. Hurricane Georges, although not a design event, was a good test of the ability of manufactured homes constructed to current standards to withstand wind damage. Only manufactured homes on Cudjoe Key were assessed; other types of housing (including modular housing) or public buildings were not included in the assessment. Therefore, the discussion that follows only pertains to manufactured housing.

The U.S. Department of Housing and Urban Development (HUD) regulates construction of manufactured homes (HUD-labeled homes), except modular units and units with the chassis removed and installed on permanent foundations. HUD regulations stipulate construction standards for manufactured homes that vary depending on the wind exposure where the home will be installed. Manufactured homes built after July 13, 1994 for Wind Zones II and III, and that are to be installed in the NFIP V-Zone within 1,500 feet of the coast, are required to have an increase in structural resistance to wind meeting American Society of Civil Engineers (ASCE) 7 Exposure D. Further provisions regarding wind-resistant doors and windows are required for manufactured homes built after January 17, 1995.

The State of Florida, Department of Highway Safety and Motor Vehicles regulates the installation of manufactured homes, except modular units which are built and installed to meet the requirements of the Standard Building Code. The state regulations are enforced at the state, county, and/or municipal level.

In addition to HUD and State regulations, the NFIP requires participating communities to adopt and enforce regulations that require that new manufactured homes and manufactured homes in SFHAs that have been substantially damaged to be elevated to the BFE and anchored to resist flotation, collapse, or lateral movement. In existing manufactured home parks or subdivisions, such as those in the area the BPAT assessed, replacement homes are only required to be elevated on a permanent foundation, and to a height of 36 inches or to the BFE, whichever is lower. If a manufactured home in an existing manufactured home park is substantially damaged by a flood, then any future manufactured homes on that lot must be elevated to the BFE.

The NFIP regulations are adopted and enforced by Monroe County as part of its floodplain management ordinance. HUD and state installation requirements for new manufactured homes are also enforced by Monroe County. In addition to the enforcement of these requirements, Monroe County has adopted provisions into its building code for foundation systems and installation of used manufactured homes.

Wind and coastal storm surge damages were evaluated on Cudjoe Key. Elevated homes were exposed to only limited storm surge; most damage was attributed to wind. In general, manufactured homes built after implementation of the new HUD and state regulations (July 1994) performed much better than older (pre-1994) manufactured homes. Damage to the newer homes was superficial and often could be attributed to an attached awning or the impact of airborne debris from an adjacent structure. The manufactured home in Figure 5-17 was located directly in the path of the storm just to the east of the eye and received maximum wind exposure. The home itself sustained only ancillary damage as a result of the awning being torn away.



FIGURE 5-17 This home suffered damage when its awning blew off. The lot next door contained an older manufactured home that was completely destroyed by high winds and coastal surge.

The successful performance of new manufactured homes installed in the Florida Keys can be attributed to four major factors:

- Manufactured homes constructed after July 13, 1994, are built to resist higher wind speeds and Exposure D and are therefore more solidly built and installed;
- The State of Florida has strong installation standards, which include a manufactured home installer education, testing, and certification program for the HUD homes;
- Monroe County's enforcement of NFIP, HUD, and state requirements; and
- The public and local governments are well educated about the new building standards.

Foundation systems for the manufactured homes installed during the past four years were typically reinforced concrete or reinforced masonry piers (Figure 5-18). These homes were at or above the coastal storm surge elevation experienced during Hurricane Georges. Most of these homes experienced only non-structural damage to lower area skirting. In some cases, water damage occurred to insulation below the floor.



FIGURE 5-18 Reinforced masonry pier foundation system under a newer manufactured home that performed well. The air conditioner compressor (circled) washed under the home provides evidence of the coastal surge at this location.

Homes generally appeared to be well anchored to the foundation piers. Many had steel plates attached to the piers and secured to the frame with large bolts (Figure 5-19). There were usually at least three connections per beam under the home. The minimum number observed was two, located at the ends of each beam.



FIGURE 5-19 Reinforced masonry pier with metal anchoring plate.

As stated earlier, most of observed damages were to older manufactured homes that were not constructed to the current HUD code or installed to the current standards that are being enforced by Monroe County. Aside from the home construction standards, deficiencies in older manufactured homes include a lack of adequate elevation, the use of un-reinforced piers (dry stacked blocks), inadequate anchors, and attached site-built additions. Although these issues are addressed in the current regulations enforced by the county, it is important to mention them in this report.

Older manufactured homes were typically elevated 1 to 2 feet on dry stacked blocks. These homes were damaged and sometimes destroyed by a combination of wind and coastal storm surge (Figure 5-20).



FIGURE 5-20 Older, non-elevated manufactured home with an addition that sustained substantial damage.

Some of the anchoring and installation problems observed on older homes included poorly attached anchors, lack of corrosion resistant materials, and homes not anchored tightly against support piers (Figures 5-21 to 5-23). Another anchoring problem observed was improperly attached tie-down straps (Figure 5-24). Figure 5-25 shows a correct strap installation that was observed.

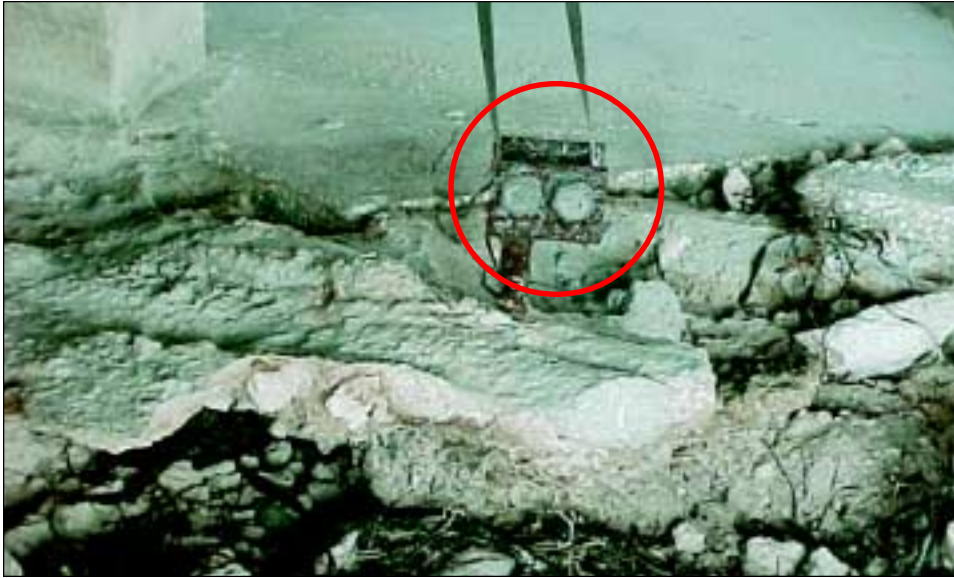


FIGURE 5-21 This anchor is only encased on the edge of the concrete fill pad and could easily be dislodged when the home is subjected to more severe wind or flood loads.



FIGURE 5-22 Inadequate turnbuckle anchor installed by homeowner on this older manufactured home. The home was severely damaged due to the lack of elevation, an unreinforced foundation system, and poor anchoring.



FIGURE 5-23 Rusty anchor under an older manufactured home. The State of Florida mandated galvanized anchors after January 1, 1999.



FIGURE 5-24 Improper strap installation. The buckle should be positioned where the strap wraps around the beam as shown in Figure 5-25.



FIGURE 5-25 Proper strap installation.

Manufactured homes that sustained the most damage appeared to be older homes with attached decks, porches, and awnings (Figure 5-26). Although undamaged during this storm, the manufactured home in Figure 5-27 could sustain significant damage if hurricane-force winds or storm surges were to get under the deck and pull it away from the building. It should be noted that site-built, attached additions to manufactured homes are no longer permitted after March 1997.



FIGURE 5-26 The addition to this manufactured home was destroyed, causing considerable damage to the rest of the home.



FIGURE 5-27 The underside of a deck that has been attached to the sidewall of a new manufactured home. The deck is not anchored as well as the home.